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November 6, 2002

Via Electronic Filing

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, DC 20554

Re: ***Ex Parte Presentation***:
IB Docket No. 01-185

Dear Ms. Dortch:

Yesterday, November 5, 2002, Alan Auckenthaler, Vice President of the Americas and General Counsel of Inmarsat, Richard Barnett of Telecomm Strategies, and the undersigned, met with the following Commission representatives: Edmond J. Thomas, Bruce A. Franca, Alan J. Scrime, Geraldine Matise, and Ira R. Keltz, all of the Office of Engineering and Technology.

The topics of discussion were those described in the enclosed set of presentation materials and the Inmarsat positions of record in this proceeding. Copies of the record submissions listed on the attached page were made available to those individuals. Copies of this letter are being provided to those individuals as well.

An original and one copy are enclosed.

Respectfully submitted,

John P. Janka

Enclosures

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TABLE OF CONTENTS

Presentation to the Federal Communications Commission Office of Engineering and Technology

Terrestrial Use of the L-Band

IB Docket No. 01-185

Inmarsat Ventures plc

November 5, 2002

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Topics for Discussion

- Why currently operational L-band satellite systems would be uniquely affected by ATC interference
- Nature of terrestrial L-band interference
  - into MSS spacecraft
  - into mobile earth terminal receivers
- Why technical limits on terrestrial L-band use
  - would not solve ATC interference problems
  - would constrain future satellite system design
- Parameters that must be taken into account in any ATC technical limits that are considered
- Why L-band warrants a different solution than 2 GHz

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Why L-Band Is Uniquely Affected by ATC

- Different operating satellite systems around the world share L-band on a co-frequency basis in different geographic areas
- International sharing agreements require L-band to be reassigned annually among systems based on changing demand for MSS service
- In contrast, each U.S. licensed 2 GHz system has a discrete segment of spectrum to use
  - does not overlap with other systems
  - not subject to dynamic reassignment, as with L-band
- Non-conforming L-band ATC uses in the U.S. would impermissibly cause harmful interference outside the U.S. (RR 4.4, 8.5)

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L-Band Terrestrial Interference into Inmarsat MSS Satellite

- Consequences of ATC interference into Inmarsat satellite receiver
  - Depending on levels of interference, ATC uses can
    - Degrade quality of service to users
    - Constrain spectrum available for MSS service in certain geographic areas
    - Reduce overall capacity of system to serve users
- Two types of interference from aggregate emissions of multiple low-powered terrestrial handsets
    - Co-frequency interference, affecting Inmarsat satellite receive beams serving areas *outside* the U.S.
    - Unwanted emissions, interfering with Inmarsat satellite receive beams serving areas *within* the U.S.

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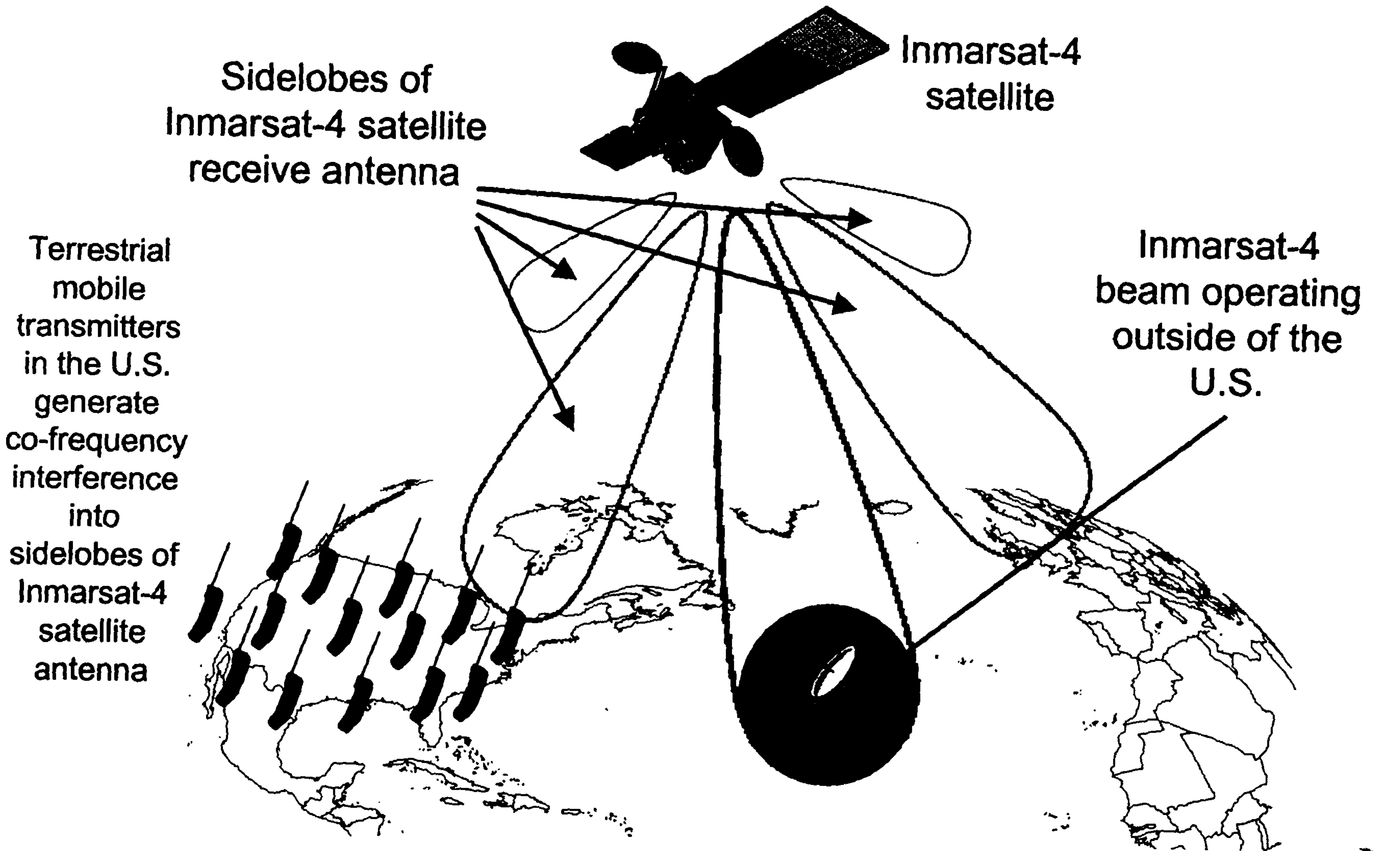
Uplink Interference from Terrestrial Transmitters (Co-Frequency, Non Co-Coverage)



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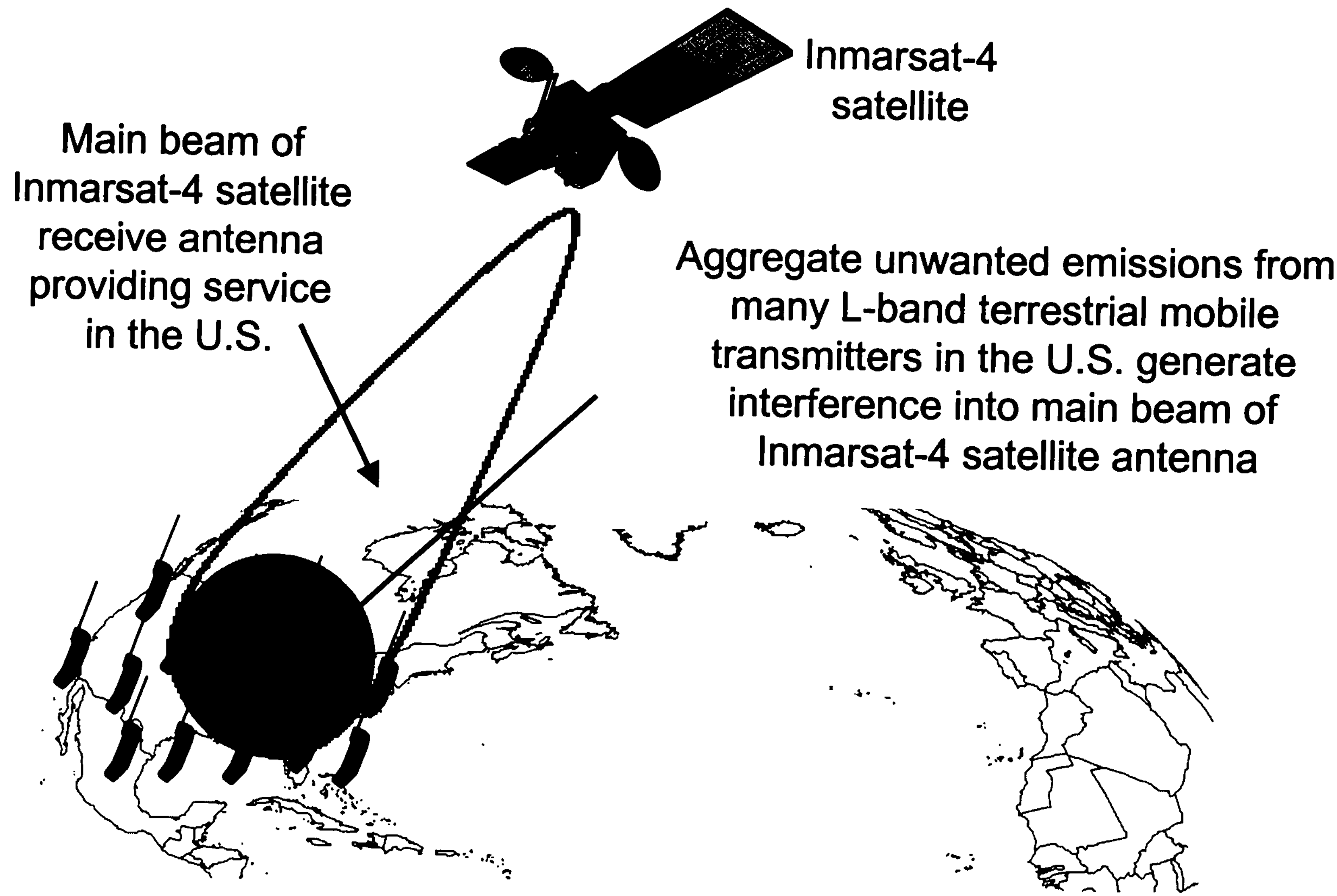
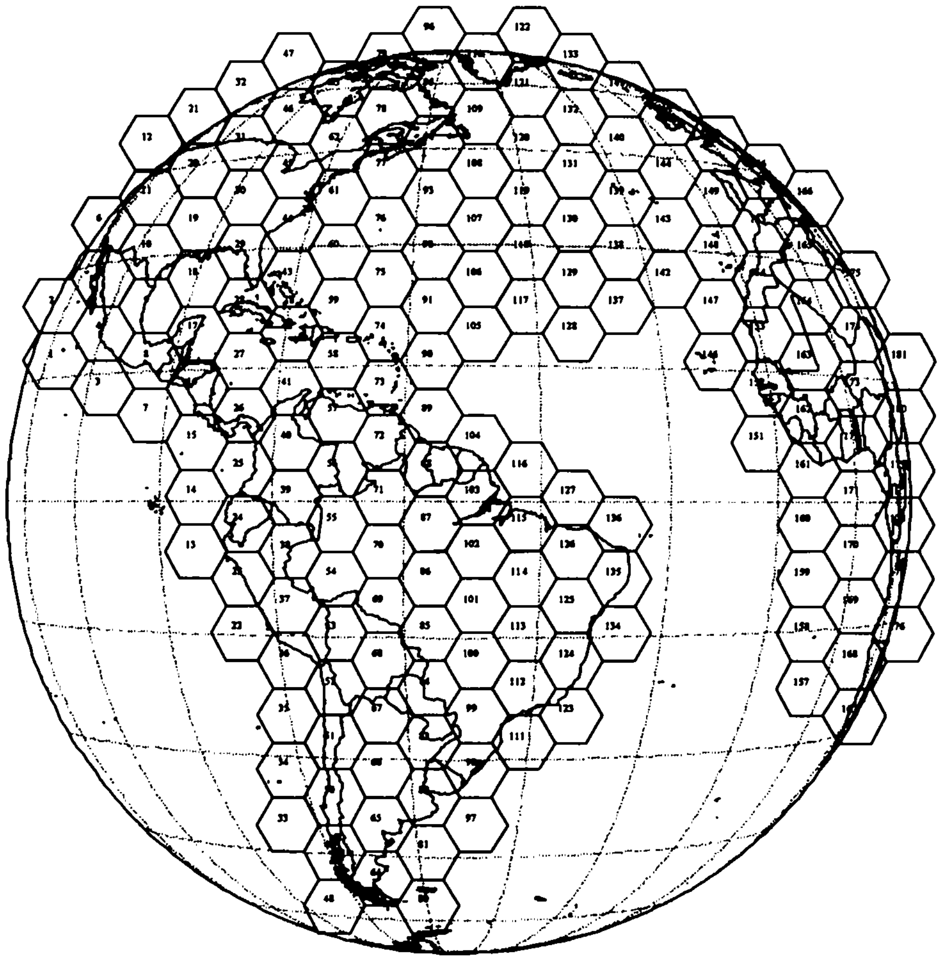
Uplink Interference from Terrestrial Transmitters (Unwanted L-Band Emissions, Co-Coverage)



Example of Inmarsat Service Area (Inmarsat-4 at 54° W.L.)



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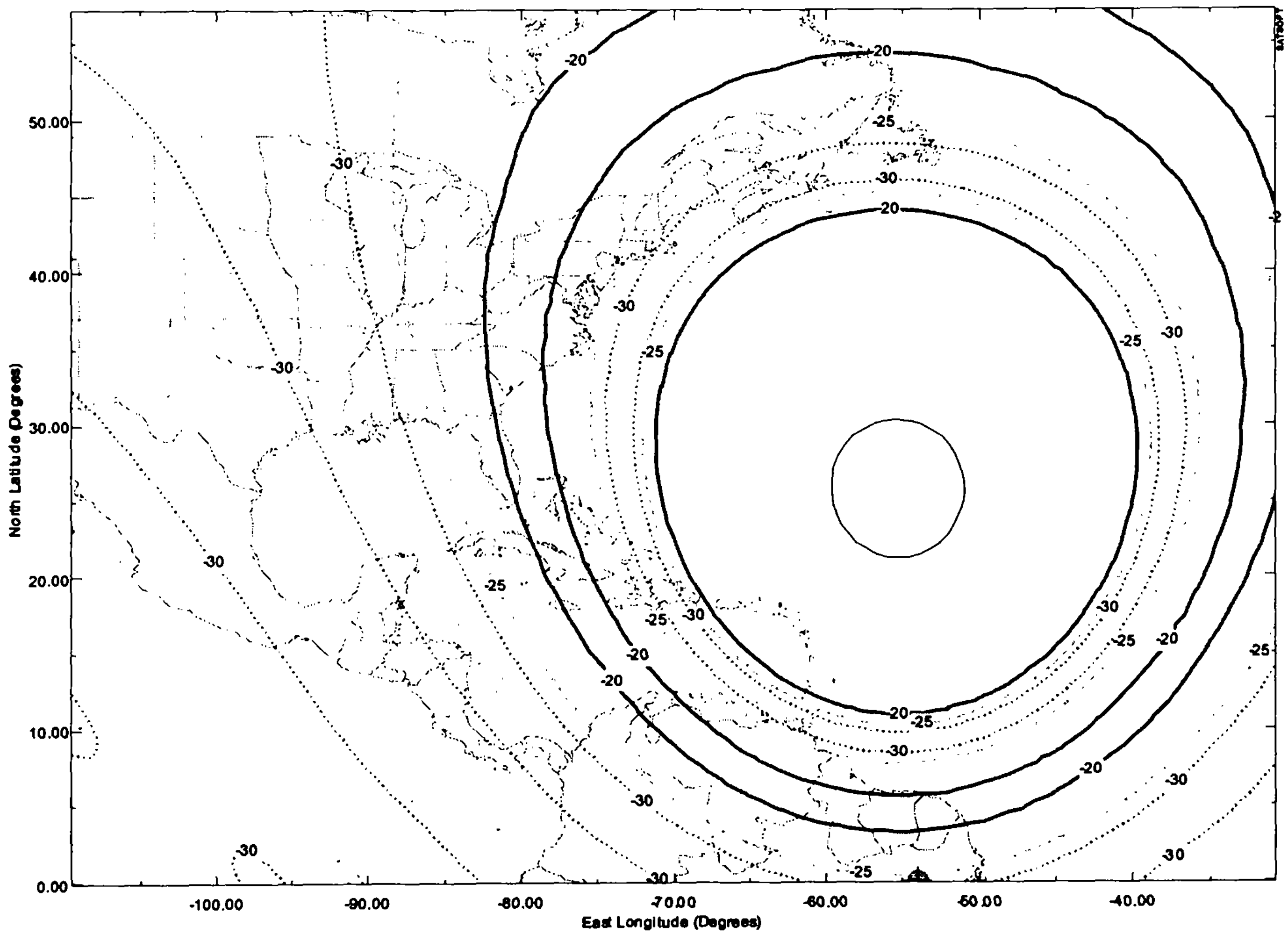
Example of Inmarsat-4 Sidelobes



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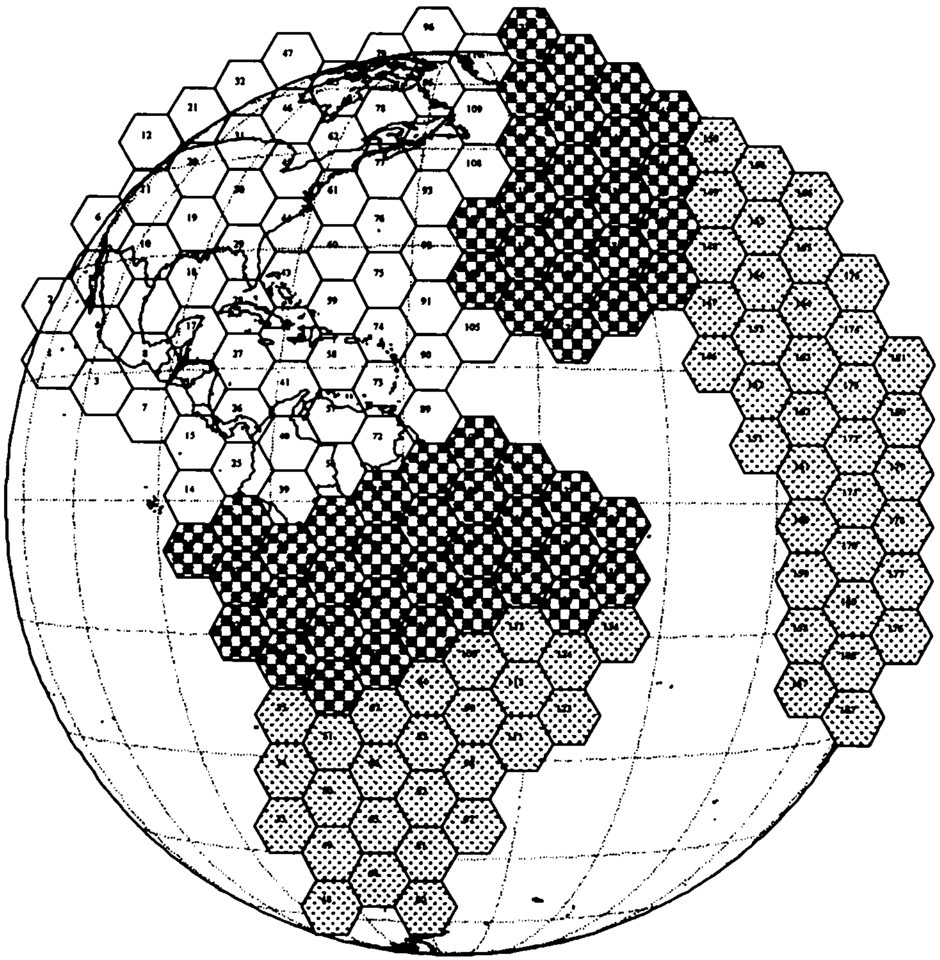
Example of Terrestrial L-band Use Limiting Capacity of Inmarsat-4 Spacecraft



<20 dB

20-30 dB

>30 dB

I-4 beams in which MSV *satellite* use likely precludes co-frequency reuse

I-4 beams in which *terrestrial* use in the U.S. impacts co-frequency coverage outside the U.S.

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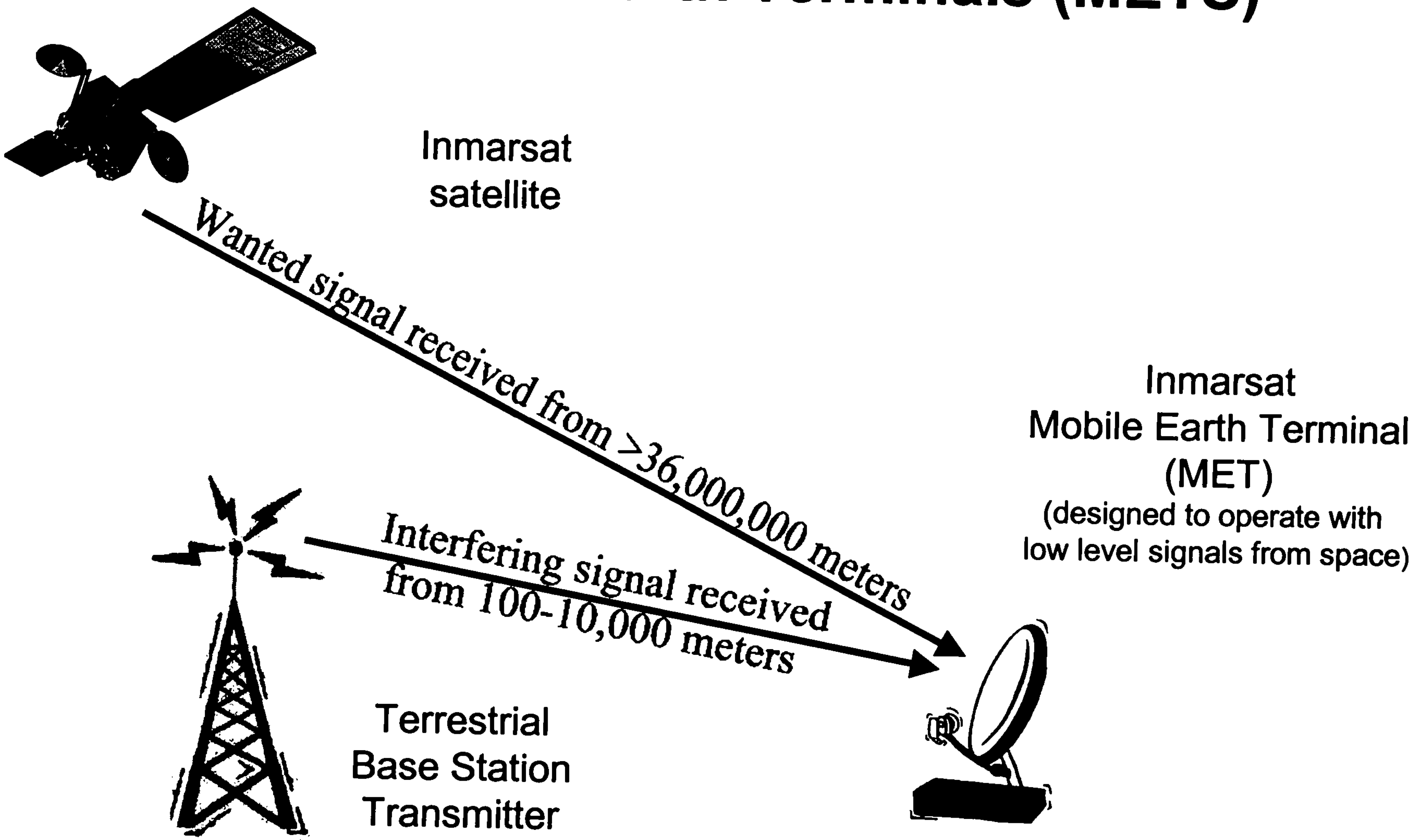
L-Band Terrestrial Interference into Inmarsat Mobile Earth Terminals (METS)

- Consequences of interference into Inmarsat METS:
  - Aeronautical terminals will not operate when flying near or over a terrestrial base station
  - Land mobile terminals will not operate near a terrestrial base station
  - Maritime terminals will not operate near a terrestrial base station
- Two types of interference into Inmarsat terminals in U.S.
  - High level terrestrial signal outside of the MET receive bandwidth causes overload of the MET receiver
  - Unwanted emissions from terrestrial transmitter fall in the MET receiver band
- Inmarsat users have experienced this type of terrestrial interference before

Nature of Terrestrial Interference into L-Band MSS Mobile Earth Terminals (METS)



Necessary Constraints on L-Band Terrestrial Emissions

- Co-frequency terrestrial operations in any part of uplink L-band <u>must be avoided, even in non-co-coverage cases</u>
- To protect satellites, would need enforceable and monitorable limit on aggregate power emitted in MSS uplink band
  - Must constrain *all transmitters* within affected sidelobes of MSS satellites
    - In U.S., Mexico, Canada, Central and South America, etc.
- Limits that protect MSS satellite receivers would not support a viable terrestrial service

Aggregate Limits on L-Band Terrestrial Emissions Are Not Legally Sustainable

- Any rule the FCC adopts to prevent ATC interference into MSS must be practically implementable
- No aggregate terrestrial areal EIRP limit is enforceable
  - Cannot be accurately measured at the spacecraft
  - Noise contributions from different ATC sources cannot be identified
    - Neither FCC nor affected spacecraft operator can tell who is generating the interference that exceeds the aggregate limit
    - Every contributing source could say it cannot be identified as the source of the problem
      - Could blame problem on ATC of another operator
        - » In the US
        - » In another country within the sidelobe of the spacecraft

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Limiting L-Band Terrestrial Emissions Does Not Solve the MET Overload Problem

- *Cannot reconcile needed protection of METs with operational requirements of terrestrial systems*
- METs are used in and near urban and suburban areas
  - airports and flight paths
  - waterways and ports
  - emergency, news gathering and other high-data-rate communications on land
- EIRP limits that allow reliable terrestrial operations still produce "exclusion zones" where Inmarsat METs could not reliably operate
- EIRP limits that protect METs result in unreliable terrestrial operation (e.g. only in buildings)

Adopting Terrestrial Limits at L-Band Constrains Future Satellite Technology

- New technology that increases satellite system efficiency also raises susceptibility to terrestrial interference
  - Smaller spot beams
    - provide greater capacity
    - increase co-frequency reuse of spectrum
    - allow geographically closer coverage for co-channel sharing among competing satellite systems
    - support lower cost, lower-power-density METS capable of transmitting at higher data rates
    - BUT higher satellite gain makes links more interference sensitive
  - Higher order modulation schemes (such as 8PSK and 16 QAM)
    - increase efficiency by allowing information to be transmitted in less bandwidth
    - BUT these modulation techniques also require higher C/N and therefore are more sensitive to interference

ATC Deployment Would Stop The Evolution of MSS Networks

- MSS spacecraft have evolved using significantly better G/T performance than systems before them

Satellite network	Inmarsat-2	Inmarsat-3	ACeS	Thuraya	Inmarsat-4	MSV
Beam type	Global	Large spot	Small spot	Small spot	Small spot	Small spot
Deployed (year)	1992	1997	2000	2000	2003-4	TBD
Gain at beam peak (dBi)	18.5	27	44.5	45	41	42.5
G/T at beam peak (dB/K)	-12	-2.5	15.3	16	13	16

- ~10 dB performance improvement per generation has been typical
- Performance improvement supports
  - Smaller spot beams
  - Greater system capacity
  - Increased frequency reuse
  - Provision of lower cost service
  - Smaller, more portable, and less expensive earth terminals
- Some MSS spacecraft operating today have higher G/T than Inmarsat-4
- ***ATC limits designed to protect only today's spacecraft would preclude similar evolution in spacecraft network design***

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Shielding and Other Propagation Effects Do Not Adequately Mitigate Interference

- Measured propagation data contradicts MSV assumption that terrestrial signal fade can protect spacecraft and METs for virtually all of the time
- Shielding is greatly reduced by geometries that exist in cities (e.g. orientation of roads towards GSO)
- Significant fading occurs for small percentages of the time, which allows wanted links to perform satisfactorily
- Since the fading models quoted by MSV are meant for wanted links, they do not predict fading levels for large percentages of the time, as needed for predicting levels of interfering signals
- Unreasonable to assume ATC uses will occur mostly in buildings

Appropriate Technical Factors In Calculating ATC Limits: Uplink Band

- Must quantify FCC-permissible reduction in spacecraft capacity allowed to be caused by aggregate ATC emissions
  - No more than 1% delta T/T into any spacecraft should be permitted
  - Need allowance for G/T improvement on future generations of spacecraft
  - Illustrative calculation:

Inmarsat-4 Satellite G/T	dB/K	13
Inmarsat-4 Satellite Antenna Gain	dBi	41
Inmarsat-4 Satellite Receive Noise Temp	K	650
Inmarsat-4 Satellite Receive Noise Spectral Density	dBW/Hz	-200.5
Allowance for ATC interference	%	1
Interference due to ATC (power density)	dBW/Hz	-220.5
ATC power-flux density limit to protect I-4	dBW/m2/Hz	-235.8
Factor to allow future spacecraft technology development	dB	-20.0
Possible ATC power-flux density limit	dBW/m2/Hz	-255.8

- Operations beyond this limit might be possible based on any international coordination agreement with affected satellite systems that separates out frequency and geographic reuse, and establishes spacecraft sidelobe performance

Appropriate Technical Factors In Calculating ATC Limits: Uplink Band

- Other critical factors:
  - Apportionment of aggregate PFD limit in uplink band among
    - various countries within sidelobe of affected spacecraft
    - ATC systems within the US
  - Practical means for monitoring and controlling terrestrial emissions in uplink band and enforcing violations of limits
  - Practical means of cutting off service to consumers who have been sold handsets that result in violation of the aggregate limit
  - Practical means for changing terrestrial frequency band assignments to take into account Mexico City MOU spectrum reassignments
- Conclusion: Uplink limits that adequately protect MSS systems greatly constrain terrestrial uses of L-band

Appropriate Technical Factors In Calculating ATC Limits: Downlink Band--Overload/Co-Channel Limits

- Illustrative calculation:

Threshold for Overload of Inmarsat MES Terminal	dBW	-120
Distance of Inmarsat MES Terminal from Terrestrial Transmitter	m	50
Free Space Loss (Line-of-Sight)	dB	70
Gain of Inmarsat MES Terminal towards Terrestrial Transmitter	dBi	0
Requirement EIRP limit	dBW	-50

- Relevant considerations
  - Distance around terrestrial transmitter where MET will be protected
  - Limitations on number and location of terrestrial transmitters in downlink band to minimize "exclusion zones" where METs will not work
  - Power control and voice activation should not be taken into account as overload is caused by peak power
  - Polarization factor should not be used as it would limit design of future MSS systems as well as possible full frequency MSS reuse
- **Conclusion***:* Downlink band limits that adequately protect MSS systems greatly constrain terrestrial uses of L-band

Appropriate Technical Factors In Calculating ATC Limits: Downlink Band--Unwanted Emissions Limits

- Illustrative calculation:

Inmarsat MES Receive Noise Temp	K	150
Inmarsat MES Receive Noise Spectral Density	dBW/Hz	-206.8
Increase in noise from ATC	%	1
	dBW/Hz	-226.8
Distance of Inmarsat MES Terminal from Terrestrial Transmitter	m	50
Free Space Loss (Line-of-Sight)	dB	70
Power Control Reduction	dB	6
Voice Activity Reduction	dB	0
Gain of Inmarsat MES Terminal towards Terrestrial Transmitter	dBi	0
Terrestrial transmitter unwanted EIRP Limit	dBW/Hz	-150.8
	dBw/4 kHz	-114.8
	dBW/MHz	-90.8

- Relevant considerations
  - Distance around terrestrial transmitter where MET will be protected
  - Limitations on number and location of terrestrial transmitters in downlink band to minimize "exclusion zones" where METs will not work
  - Power control could be taken into account in appropriate circumstances.
  - Voice activation not relevant unless data services are *precluded* on ATC systems.
  - Polarization factor should not be used as it would limit design of future MSS systems as well as possible full frequency MSS reuse

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Interference Issues with Terrestrial Use of Big LEO Band

- Terrestrial use of the Big LEO band presents an interference issue for satellite receive antennas operating in the L-band
- 1610-1626.5 segment of the Big LEO band is immediately adjacent to the L-band uplink band
- Large numbers of terrestrial transmitters in the 1610-1626.5 GHz band could produce, in the aggregate, harmful levels of out-of-band emissions
- Must constrain out-of-band emissions from 1610-1626.5 GHz to avoid interference into Inmarsat satellite receive antennas

L-Band Warrants Different Solution Than 2 GHz May Warrant

- Heavy incumbent use of L-band for satellite services
- Sharing of L-band on a co-frequency basis by multiple satellite systems
- Disruption of existing military, safety, commercial and humanitarian services provided at L-band
- Billions invested in in-orbit L-band spacecraft and hundreds of thousands of METs
- Existing U.S. commitments under international L-band coordination agreement
- Inadequacy of available spectrum to support current MSS demands at L-band

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Conclusion

- Terrestrial use of the L-band should not be permitted
  - due to heavy incumbent MSS use of the band
  - would cause harmful interference into Inmarsat spacecraft and mobile earth terminals
  - would constrain deployment of more efficient satellite technology
  - would reduce L-band spectrum critically needed for MSS service
- Effective limits on broad-scale terrestrial use of the L-band are not feasible or enforceable
- Co-frequency terrestrial operations in uplink part of L-band must be avoided, even in non-co-coverage cases
- Urban and suburban "fill-in" service can be provided in other frequency bands than the L-band
- Different solution may be possible in the 2 GHz band

Sources: Inmarsat Technical Analyses

- *Technical Annex to Comments of Inmarsat Ventures plc*, FCC IB Docket No. 01-185 (filed October 22, 2001)
- *Supplemental Technical Annex to Reply Comments of Inmarsat Ventures plc*, FCC IB Docket No. 01-185 (filed November 13, 2001)
- *Ex parte* presentation of Inmarsat, FCC IB Docket No. 01-185, File No. SAT-ASG-20010302-00017 *et al.* (filed February 26, 2002)
- "Quantification of Harmful Co-Channel L-Band Uplink Interference into Inmarsat-4 From MSV ATC Uses, Versus MSV Mobile Earth Terminal Uses," at Attachment, *ex parte* presentation of Inmarsat, FCC IB Docket No. 01-185, File No. SAT-ASG-20010302-00017 *et al.* (filed May 10, 2002)
- "Inmarsat Response to MSV Ex Parte of March 28 Concerning 'Monitoring and Control of Ancillary Terrestrial Emissions by MSV's Space Segment,'" *ex parte* presentation of Inmarsat, FCC IB Docket No. 01-185, File No. SAT-ASG-20010302-00017 *et al.* (filed May 15, 2002)
- "MSV is Unable to Operate ATC Without Using Additional Spectrum Beyond That Used for Its MSS System" at §3, *ex parte* presentation of Inmarsat, FCC IB Docket No. 01-185, File No. SAT-ASG-20010302-00017 *et al.* (filed May 21, 2002)
- "Inmarsat's Reply to the 'Further Technical Analysis' of Mobile Satellite Ventures, dated July 29, 2002," *ex parte* presentation of Inmarsat, FCC IB Docket No. 01-185, File No. SAT-ASG-20010302-00017 *et al.* (filed September 9, 2002)

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